

3. Climate

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The Intergovernmental Panel on Climate Change (IPCC) estimates that aviation accounted for 4.1% percent of global transportation GHG emissions. In the United States, U.S. Environmental Protection Agency (EPA) data indicate that commercial aviation contributed 6.6% percent of total CO₂ emissions in 2013, compared with other sources, including the remainder of the transportation sector (20.7 percent), industry (28.8 percent), commercial (16.9 percent), residential (16.9 percent), agricultural (9.7 percent) and U.S. territories (.05 percent).¹

Scientific research is ongoing to better understand climate change, including any incremental atmospheric impacts that may be caused by aviation. Uncertainties are too large to accurately predict the timing, magnitude, and location of aviation's climate impacts; however, it is clear that minimizing GHG emissions and identifying potential future impacts of climate change are important for a sustainable national airspace system.

Increasing concentrations of GHGs in the atmosphere affect global climate.² GHG emissions result from anthropogenic sources including the combustion of fossil fuels. GHGs are defined as including carbon CO₂, methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆).³ CO₂ is the most important anthropogenic GHG because it is a long-lived gas that remains in the atmosphere for up to 100 years.

¹ GHG allocation by economic sector. Environmental Protection Agency (2015). *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013*. Available at: <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html#fullreport>

² IPCC (2014). *Fifth Assessment Report*. Available at: <https://www.ipcc.ch/report/ar5/syr/> United States Global Change Research Program (2009). *Global Climate Change Impacts in the United States*. Available at: <http://www.globalchange.gov/what-we-do/assessment/previous-assessments/global-climate-change-impacts-in-the-us-2009>.

³ Executive Order 13693, *Planning for Federal Sustainability in the Next Decade*. Available at: <https://www.whitehouse.gov/the-press-office/2015/03/19/executive-order-planning-federal-sustainability-next-decade>

Climate change is a global phenomenon that can have local impacts.⁴ Scientific measurements show that Earth's climate is warming, with concurrent impacts including warmer air temperatures, increased sea level rise, increased storm activity, and an increased intensity in precipitation events. Research has shown there is a direct correlation between fuel combustion and GHG emissions.

3.1. Regulatory Setting

Exhibit 3-1 lists the primary statutes, regulations, and Executive Orders related to climate.

Exhibit 3-1. Statutes, Regulations, and Executive Orders Related to Climate

Statute, Regulation, or Executive Order	Location in U.S. Code or <i>Federal Register</i>	Implementing Regulation or Support Document	Oversight Agency ^a	Summary ^a
Clean Air Act	42 U.S.C. §§ 7408, 7521, 7571, 7661 et seq.	40 CFR parts 85, 86, and 600 for surface vehicles 40 CFR part 60 for stationary power generation sources	EPA	Regulates GHG emissions from on-road surface transportation vehicles and stationary power generation sources.
Executive Order 13514 Federal Leadership in Environmental Energy and Economic Performance	74 <i>Federal Register</i> 52117 (October 8, 2009)	<i>Federal Greenhouse Gas Accounting and Reporting Guidance: Technical Support Document</i> (October 26, 2010)	None	Makes it the policy of the United States that Federal agencies measure, report, and reduce their GHG emissions from direct and indirect activities. Provides for development of the Technical Support Document that establishes reporting criteria for GHGs.
Executive Order 13653, <i>Preparing the United States for the Impacts of Climate Change</i>	78 <i>Federal Register</i> 66817, (November 6, 2013)	None	None	Builds on a previously released (and since revoked) <i>EO 13514 Federal Leadership in Environmental Energy, and Economics Performance</i> to establish direction for federal agencies on how to improve on climate preparedness and reliance strategies.

⁴ As explained by the EPA, “greenhouse gases, once emitted, become well mixed in the atmosphere, meaning U.S. emissions can affect not only the U.S. population and environment but other regions of the world as well; likewise, emissions in other countries can affect the United States.” EPA, (2009) Climate Change Division, Office of Atmospheric Programs, *Technical Support Document for Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act* 2-3. Available at: http://www.epa.gov/climatechange/Downloads/endangerment/TSD_Endangerment.pdf.

Statute, Regulation, or Executive Order	Location in U.S. Code or <i>Federal Register</i>	Implementing Regulation or Support Document	Oversight Agency ^a	Summary ^a
Executive Order 13693, <i>Planning for Federal Sustainability</i>	80 <i>Federal Register</i> 15869	Forthcoming	None	Reaffirms the policy of the United States that Federal agencies measure, report, and reduce their GHG emissions from direct and indirect activities. Sets sustainability goals for all agencies to promote energy conservation, efficiency, and management while by reducing energy consumption and GHG emissions. Builds on the adaptation and resiliency goals in EO 13693 to ensure agency operations and facilities prepare for impacts of climate change. Revokes EO 13514.

^a U.S.C. = United States Code; Code of Federal Regulations (CFR)

In response to Executive Order 13514, Council on Environmental Quality (CEQ) developed *Federal Greenhouse Gas Accounting and Reporting Guidance* (October 6, 2010) (hereafter “Federal protocol”), which serves as the Federal government’s official GHG reporting protocol. GHGs result primarily from combustion of fuels, and there is a direct relationship between fuel combustion and metric tonnes of CO₂ (MT CO₂). In accordance with the Federal protocol, and to provide a single metric that embodies all GHGs, emissions should be discussed and reported in metric tonnes of CO₂ equivalent (MT CO₂e). In December 2014, CEQ issued revised draft NEPA guidance for considering the effects of climate change and GHG emissions.⁵ The draft CEQ guidance recommended consideration of: (1) the potential effects of a proposed action or its alternatives on climate change as indicated by its GHG emissions; (2) the implications of climate change for the environmental effects of a proposed action or alternatives. This chapter provides guidance on both of these considerations for FAA actions. There may also be state or local requirements applicable to particular proposed projects. Other Federal agencies with permitting or approval responsibility may also have guidance that should be considered. Early coordination with other agencies is recommended in order to identify any documentation needs.

3.1.1. Overview of the NEPA Review Process

Discussion of potential climate impacts should be documented in a separate section of the NEPA document, distinct from air quality, under a heading labeled Climate.

⁵ CEQ (2014). Revised Draft Guidance, *Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in NEPA Reviews*, 79 *Federal Register* 77801 (December 24, 2014). Available at: <https://www.federalregister.gov/articles/2014/12/24/2014-30035/revised-draft-guidance-for-federal-departments-and-agencies-on-consideration-of-greenhouse-gas>

- If GHGs and climate are not relevant to the proposed action and alternative(s) (i.e., because there would be no GHG emissions), this should be briefly noted and no further analysis is required.
- Where the proposed action or alternative(s) would not result in a net increase in GHG emissions (as indicated by quantitative data or proxy measures such as reduction in fuel burn, delay, or flight operations), a brief statement describing the factual basis for this conclusion is sufficient.
- Where the proposed action or alternative(s) would result in an increase in GHG emissions, the emissions should be assessed either qualitatively or quantitatively as described below. There are no significance thresholds for aviation or commercial space launch GHG emissions, and it is not currently useful for the NEPA analysis to attempt to link specific climate impacts to the proposed action or alternative(s) given the small percentage of emissions aviation and commercial space launch projects contribute.

3.2. Affected Environment

For FAA project-level actions, the affected environment section for climate is highly dependent on the project itself and is defined as the entire geographic area that could be either directly or indirectly affected by the proposed project.

For an air traffic action, the study area is typically larger than the immediate vicinity of an airport, can incorporate more than one airport, and may extend vertically up to the extent of the project changes.

For airport actions, the study area is defined by the extent of the project changes (i.e., immediate vicinity of the airport) and should reflect the full extent of aircraft movements as part of the project changes. Please see FAA's Air Quality Handbook for more information for defining the study area.

As explained in Section 3.3.1 below, analysis of GHG emissions should be quantitatively assessed in certain circumstances, but otherwise may be qualitatively assessed. Where the analysis is quantitative, the affected environment section for climate should provide the quantitative data for the no action alternative, which provides the baseline of existing GHG emissions in the study area. Where the analysis is qualitative, the affected environment section should be tailored to the qualitative analysis.

The affected environment section should also discuss the current level of preparedness in the study area with respect to the impacts of climate change. This involves describing current measures that are in place within the study area to adapt to the impacts of climate change (e.g., sea level rise, stronger or more frequent storms, etc.). This discussion should be concise and may be quantitative or qualitative, depending on the nature of a project area.

3.3. Environmental Consequences

3.3.1. NEPA Evaluation Process

The draft CEQ guidance affirmed the applicability of NEPA and the CEQ Regulations to GHGs and climate. As noted by CEQ, "climate change is a particularly complex challenge given its global nature and inherent interrelationships among its sources, causation, mechanisms of action,

and impacts; however, analyzing the proposed action's climate impacts and the effects of climate change relevant to the proposed action's environmental outcomes can provide useful information to decisionmakers and the public and should be very similar to considering the impacts of other environmental stressors under NEPA.”⁶ CEQ specifically asks agencies to consider⁷:

- 1) The potential effects of a proposed action on climate change as indicated by its GHG emissions; and
- 2) The implications of climate change for the environmental effects of a proposed

Considering GHG emissions for an FAA NEPA review should follow the basic procedure of considering the potential incremental change in CO₂ emissions that would result from the proposed action and alternative(s) compared to the no action alternative for the same timeframe, and discussing the context for interpreting and understanding the potential changes. For FAA NEPA reviews, this consideration could be qualitative (e.g., explanatory text), but may also include quantitative data (e.g., calculations of estimated project emissions). Proxy measurements such as delay time or fuel burn can be used in qualitative considerations, for example, to explain that the proposed action would cause no change or a decrease in emissions.

CO₂e emissions should be quantified under the following circumstances:

- When there is reason to quantify emissions for air quality purposes, then MT CO₂e should also be quantified and reported in the NEPA document; or
- When fuel burn is computed and reported in the NEPA document, quantification of MT CO₂e calculated from the fuel burned should also be included in the document.⁸

Below are descriptions of two potential circumstances that may be encountered, with explanations of how the NEPA evaluation process should be conducted for each:

1. *Proposed action and alternative(s) would not increase GHG emissions compared to the no action alternative.* If the proposed action and alternative(s) would cause no net change or a net reduction in GHG emissions, based on a quantitative or qualitative assessment, this should be briefly explained in the Environmental Assessment (EA) or Environmental Impact Statement (EIS) and no further consideration of GHGs is necessary.
2. *Proposed action or alternative(s) would result in an increase of GHG emissions over the no action alternative.* GHG emissions that would be caused by a project should be discussed in their context. The process for considering the context of MT CO₂e is described below. If GHG emissions are not quantified because other air emissions are not quantified and/or fuel burn is unable to be computed, context should be considered qualitatively. When reporting quantified calculations, the following guidelines on data analysis should be followed. When in doubt, the appropriate FAA Headquarters program office or FAA Office of Environment and Energy (AEE) should be consulted regarding how best to scope the analysis and discussion of GHG emissions.

⁶ Ibid.

⁷ Ibid.

⁸ The draft CEQ Guidance has recommended a 25,000 metric ton threshold for disclosure purposes. FAA has not adopted this disclosure threshold. FAA discloses CO₂ emissions in the NEPA documentation whenever calculations are provided through modeling, regardless of whether it is above or below the 25,000 tons.

3.3.2. Data Analysis

Of the six recognized GHGs, only CO₂ is a direct aircraft combustion product. For FAA NEPA evaluations, the amount of CO₂ and/or fuel burn from aircraft operations should be calculated from an FAA-approved tool appropriate for the action. The Aviation Environmental Design Tool (AEDT) can generate CO₂ emissions for aircraft operations, as well as ground service equipment, motor vehicles, and other sources of emissions. If aircraft CO₂ is not calculated directly by the tools used, the CO₂ emissions should be calculated from projections of total fuel burned.

To convert consumed fuel quantities to CO₂ emissions, the following conversion factors should be used:

- 1 gallon of jet fuel consumed = 9.7438 kg of CO₂ = 0.0097438 MT CO₂
- 1 pound of jet fuel consumed = 1.4329 kg of CO₂ = 0.0014329 MT CO₂
- 1 gallon of avgas consumed = 8.3182 kg of CO₂ = 0.0083182 MT CO₂
- 1 pound of avgas consumed = 1.3864 kg of CO₂ = 0.0013864 MT CO₂

The calculation of aircraft CO₂ for an action alternative would be added to any other potential GHGs for that alternative in order to reach an overall CO₂e total for that alternative. If the proposed action involves only aircraft operational changes, then the MT CO₂e would be exactly the same as the aircraft MT CO₂. If further details are necessary to convert fuel burn to CO₂e for non-aircraft sources (e.g., stationary sources, construction equipment, etc.), then the Federal protocol should be consulted. The total MT CO₂e should be calculated for what is reasonably foreseeable, using the same analytical timeframes currently used for NEPA analyses.

The study area for climate should be congruent with the the scope of the air quality analysis. Note that non-aircraft emission sources are typically not affected by airspace and procedural actions. For an airport action, the GHG evaluation should include the same emission sources that would typically be included in the air quality analysis. For non-aircraft sources of emissions, GHG emissions should be determined from projections of fuel burn and converted to CO₂e.

3.3.3. Documentation

When CO₂e is quantified, the MT CO₂e results should be provided in a table or similar format that compares the alternatives directly. When fuel burn is computed, the MT CO₂ equal to that fuel content should be documented and discussed in the section of the document on Climate.

3.3.4. Significance Determination

There are no significance thresholds for aviation or commercial space launch GHG emissions, nor has the FAA identified specific factors to consider in making a significance determination for GHG emissions. There are currently no accepted methods of determining significance applicable to aviation or commercial space launch projects given the small percentage of emissions they contribute. CEQ has noted that “it is not currently useful for the NEPA analysis to attempt to link specific climatological changes, or the environmental impacts thereof, to the

particular project or emissions, as such direct linkage is difficult to isolate and to understand.”⁹ Accordingly, it is not useful to attempt to determine the significance of such impacts. There is a considerable amount of ongoing scientific research to improve understanding of global climate change and FAA guidance will evolve as the science matures or if new Federal requirements are established.

3.4. Reducing Emissions

Reduction of GHG emissions resulting from FAA actions contributes towards the U.S. goal of reducing aviation’s impacts on climate. For NEPA reviews of proposed FAA actions that would result in increased emissions of GHGs, consideration should be given to whether there are areas within the scope of a project where such emissions could be reduced. GHG emission reduction can come from measures such as changes to more fuel efficient equipment, delay reductions, use of renewable fuels, and operational changes (e.g., performance-based navigation procedures). However, GHG emission reduction is not mandated and will not be possible in all situations.

3.5. Climate Adaptation

The environmental consequences section should include a discussion of the extent to which the proposed action or alternatives(s) could be affected by future climate conditions, based on published sources applicable to the study area. For example, a project area’s ability to sustain impacts caused by climate changes should be described (e.g., identify current robustness and height of seawalls for coastal airports). This discussion should include any considerations to adapt to forecasted climate change conditions.

⁹ CEQ (2010). Draft Guidance, *Consideration of the Effects of Climate Change and Greenhouse Gas Emissions*, 75 Federal Register 8046 (February 23, 2010) available at <http://www.whitehouse.gov/sites/default/files/microsites/ceq/20100218-nepa-consideration-effects-ghg-draft-guidance.pdf>

Climate

Federal activities affecting all environmental impact categories are governed by many statutes, regulations, and Executive Orders. Each impact category chapter of this Desk Reference (Chapters 1-14, as applicable) contains an exhibit with a tabular overview of the major applicable Federal statutes, regulations, Executive Orders, and the agencies responsible for overseeing their implementation. This appendix supplements the background information relevant to those requirements that is provided in the chapter exhibits. Please note that these requirements may not be applicable to every FAA action, and should only be included when relevant to the proposed project.

B.3. Climate

B.3.1. Clean Air Act

The CAA is the comprehensive Federal law that regulates the emission of air pollutants from stationary and mobile sources. Among other things, the CAA authorizes the U.S. EPA to establish NAAQS for common air pollutants (known as “criteria pollutants”) to protect public health and welfare, and to regulate emissions of hazard HAPs. More information on the CAA is available at <http://www2.epa.gov/laws-regulations/summary-clean-air-act>

B.3.2. Executive Order 13514, Federal Leadership in Environmental, Energy, and Economic Performance

The Executive Order makes it the policy of the United States that Federal agencies measure, report, and reduce their Greenhouse Gas (GHG) emissions from direct and indirect activities. Provides for development of the Technical Support Document that establishes reporting criteria for GHGs. The Executive Order is available at https://www.whitehouse.gov/assets/documents/2009fedleader_eo_rel.pdf

The following statutes and Executive Orders govern the protection of coastal resources.

B.3.3. Coastal Barrier Resources Act

The Coastal Barrier Resources Act (CBRA) encourages the conservation of hurricane prone, biologically-rich coastal barriers by restricting Federal financial assistance (including disaster relief assistance provided by the Federal Emergency Management Agency (FEMA)) for development of these ecosystems. Administered by the USFWS, the CBRA established the Coastal Barrier Resources System (CBRS), a designation of relatively undeveloped coastal barriers that serve as barriers protecting the Atlantic, Gulf, and Great Lakes coasts. The CBRS currently includes 585 units, comprising nearly 1.3 million acres of land and associated aquatic habitat.

Section 6 of the CBRA provides exemptions for Federal agencies to fund certain projects within the CBRS. Under these exemptions, the FAA may provide financial support to set up, operate, or maintain navigational aids and devices that are part of the nation's air navigation system in CBRS units. Compliance with the CBRA may require consultation with the USFWS. This Act does not address Federal actions that do not involve expenditures, such as the issuance of Federal permits, licenses, or other authorizations. Areas within the CBRS can be developed provided the applicant bears the full cost. However, the FAA encourages applicants to meet the requirements of the Act.

For additional information on the CBRA, see the USFWS's website at: <http://www.fws.gov/CBRA/> or the DOI Coastal Barrier Act Advisory Guidelines at 57 *Federal Register* 52730, (November 5, 1992).

B.3.4. Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) is a Federal law which provides for management of the nation's coastal resources, including the Great Lakes. Administered by the National Oceanic and Atmospheric Administration's (NOAA's) Office of Ocean and Coastal Resource Management (OCRM), the CZMA was created to preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone.

One of the programs outlined by the CZMA is the National Coastal Zone Management Program, which is a voluntary partnership among the Federal government and coastal and Great Lakes states and territories. Under this program, state governments design unique coastal zone management programs which are subsequently approved by NOAA. Once these programs have been approved, the CZMA requires that any Federal actions that could have a reasonably foreseeable impact on a state's coastal zone (even if the action occurs outside the designated coastal zone) be consistent with the approved coastal management program for that state. Fulfilling the FAA's obligations under the CZMA may require conducting consultation with the affected state's coastal management program office.

For additional information on the CZMA, including links to NOAA's CZMA regulations, see NOAA's website at: <http://coast.noaa.gov/>

B.3.5. National Marine Sanctuaries Act

The National Marine Sanctuaries Act authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or aesthetic qualities as national marine sanctuaries. The primary objective of this Act is to protect marine resources, such as coral reefs, sunken historical vessels, or unique habitats. The Act provides the authority to issue regulations for sanctuaries, requires preparation of

management plans, authorizes NOAA to assess civil penalties, and requires Federal agencies whose actions could impact sanctuary resources to consult with the program before taking action.

For additional information on the National Marine Sanctuaries Act, see NOAA's website at: <http://sanctuaries.noaa.gov/about/legislation/>.

B.3.6. Executive Order 13089, *Coral Reef Protection*

Executive Order 13089, *Coral Reef Protection*, 63 *Federal Register* 32701, (June 16, 2998) requires Federal agencies to identify any actions that might affect coral reef ecosystems, protect and enhance the conditions of these ecosystems, and ensure that, to the extent permitted by law, the actions carried out, authorized, or funded by Federal agencies will not negatively impact or degrade coral reef ecosystems. Under this Executive Order, U.S. coral reef ecosystems are defined to mean those species, habitats, and other natural resources associated with coral reefs in all maritime areas and zones subject to the jurisdiction or control of the United States.

For additional information on

- The Executive Order, see http://www.coralreef.gov/about/executive_order13089.pdf.
- NOAA's Coral Reef Conservation Program see <http://coralreef.noaa.gov/>
- Coral Reefs in General see EPA's Coral website at http://water.epa.gov/type/oceb/habitat/coral_index.cfm

B.3.7. Executive Order 13547, *Stewardship of the Ocean, Our Coasts, and the Great Lakes*

Executive Order 13547, *Stewardship of the Ocean, Our Coasts, and the Great Lakes*, 75 *Federal Register* 43023, (July 22, 2010) ensures that the ocean, our coasts, and the Great Lakes are healthy and resilient, safe and productive, and understood and treasured, so as to promote the well-being, prosperity, and security of present and future generations. This Executive Order establishes the National Policy for the Stewardship of the Ocean and provides that Federal agencies will ensure the protection, maintenance, and restoration of the health of ocean, coastal, and Great Lakes ecosystems and resources, enhance the sustainability of ocean and coastal economies, preserve our maritime heritage, support sustainable uses and access, provide for adaptive management to enhance our understanding of and capacity to respond to climate change and ocean acidification, and coordinate with our national security and foreign policy interests. In addition, this Executive Order establishes the National Ocean Council, and directs the Council to develop a National Ocean Policy Implementation Plan. Agencies are directed to comply with the Council's recommendations, and use the best available science and knowledge to inform decisions affecting the ocean, our coasts, and the Great Lakes.

For additional information on this Executive Order, see <http://www.gpo.gov/fdsys/pkg/FR-2010-07-22/pdf/2010-18169.pdf>